

CLAIMS

What is claimed is:

1. An electrochemical cell comprising an electrode and an electrically conductive contact element facing said electrode for conducting electrical current, said electrically conductive contact element having an electrically conductive coating on at least one side of said element, said coating including a metal oxide composition which is electrically conductive.
2. The cell of claim 1 which is a fuel cell comprising an ion conducting membrane and said electrode which is a catalytic electrode on one major face of the membrane, and wherein said coating comprises fluorine doped tin oxide.
3. The cell of Claim 1 wherein said electrically conductive contact element comprises a metal substrate which is susceptible to corrosion, and said coating is a corrosion-resistant protective coating which protects said metal substrate from a corrosive environment of the cell.
4. The cell of Claim 1 wherein said electrically conductive contact element comprises a substrate formed of electrically conductive particles dispersed in a binder matrix, and said coating provides electrical contact between said substrate and said electrode.

5. The cell of Claim 1 wherein said electrically conductive contact element comprises a matrix of compacted graphite flakes impregnated with a filler.

6. The cell of Claim 1 wherein said electrically conductive contact element comprises a conductive substrate, a layer of conductive open cell foam having a first face facing said substrate and a second face facing said electrode, and wherein said coating is on said second face of said foam layer.

7. The cell of Claim 6 wherein said open cell foam has external surfaces and internal surfaces defined by openings in said open cell foam, and wherein said coating is on said internal and external surfaces.

8. The cell of Claim 7 wherein said foam has a thickness between said first and second faces, and said coating is present on said internal and external surfaces throughout said thickness.

9. The cell of Claim 8 wherein said coating is on a surface of said substrate facing said foam.

10. The cell of Claim 6 wherein said substrate is a metal sheet and said foam is a metal foam.

11. The cell of Claim 10 wherein said metal sheet is welded or braised to said metal foam.

12. The cell of Claim 1 which further includes an electrically conductive porous material disposed between said electrode and said coated electrically conductive contact element, and wherein said porous material is selected from the group consisting of carbon paper, carbon cloth and metal screen.

13. The cell of claim 1 wherein said electrically conductive contact element is a fluid distribution element, comprising:

an electrically conductive substrate having first and second major surfaces, a flow field at said first major surface for distributing fluid along said first major surface, and said coating on said first major surface.

14. The cell of claim 13 wherein said coating comprises fluorine doped tin oxide.

15. The cell of Claim 13 wherein the said substrate is selected from the group consisting of titanium, stainless steel, aluminum, a composite of electrically conductive particles dispersed in a binder matrix; and compacted graphite flakes impregnated with a filler.

16. The cell of Claim 13 wherein said flow field comprises a layer of electrically conductive open cell foam.

17. The cell of Claim 16 wherein said foam is conductive graphite foam or conductive metallic foam.

18. The cell of Claim 13 wherein said flow field comprises a series of channels in said first major surface.

19. The cell of Claim 13 wherein said flow field comprises lands defining a plurality of grooves for distributing fuel or oxidant along said first major surface.

20. The cell of Claim 13 which comprises a second flow field at said second major surface.

21. The cell of Claim 20 wherein said second flow field comprises lands defining a plurality of grooves for distributing coolant fluid along said second major surface.

22. The cell of Claim 14 wherein the fluorine content of said fluorine doped tin oxide is less than 10 weight percent.

23. The cell of claim 1 which is an electrolytic cell comprising an ion conducting electrolyte, said electrode facing the electrolyte, and said electrically conductive contact element in contact with said electrode for conducting electrical current to said electrode.

24. The cell of claim 23 wherein said electrically conductive coating comprises fluorine doped tin oxide.

25. The cell of Claim 24 wherein said electrically conductive contact element comprises a metal substrate which is susceptible to corrosion, and said coating is a corrosion-resistant protective coating which protects said metal substrate from the corrosive environment of the cell.

26. A method for inhibiting degradation of an electrically conductive contact element in a fuel cell, said cell having a proton conductive material which degrades leading to formation of corrosive species in the cell, said method comprising, including in said cell, a layer comprising fluorine doped tin oxide between said proton conductive material and said electrically conductive contact element, to thereby inhibit corrosion of said electrically conductive contact element.

27. The method of Claim 26 wherein the proton conductive material comprises perfluoronated sulfonic acid polymer.

28. The method of Claim 26 wherein the proton conductive material comprises perfluorocarbon sulfonic acid polymer and polytetrafluoroethylene, at least one of which degrades to form HF.

29. The electrochemical cell of claim 1 wherein said electrically conductive contact element comprises a bipolar plate including a sheet metal product having said coating which is a corrosion-resistant protective coating including a metal oxide composition having a treatment which ensures conductivity.

30. The cell of claim 29 wherein the treatment has been carried out in order to produce a crystal structure of the metal oxide composition coating which ensures conductivity.

31. A product in accordance with claim 29 wherein the treatment takes the form of a galvanic coating consisting of one of the elements aluminum, chromium, silver, antimony or molybdenum applied directly below the metal oxide composition coating.

32. A product in accordance with claim 29 wherein the treatment is executed as a doping.

33. A product in accordance with claim 32 wherein the protective coating consists of at least one layer.

34. A product in accordance with claim 32 wherein the protective coating comprises an oxide of one of the following elements or alloys of these elements: tin, zinc, indium.

35. A product in accordance with claim 32 wherein the protective coating comprises a first layer of a metal oxide, a second layer of a dopant which ensures conductivity, and a third layer of a metal oxide.

36. A product in accordance with claim 29 wherein the protective coating comprises an alternating layer sequence of metal oxide composition and dopants which ensure conductivity

37. A product in accordance with claim 29 wherein the protective coating comprises at least two layers.

38. A product in accordance with claim 32 wherein the doping which ensures the conductivity comprises at least one element of the group aluminum, chromium, silver, boron, fluorine, antimony, chlorine, bromine, phosphorus, molybdenum and/or carbon.

39. A product in accordance with claim 29 wherein the protective coating comprises a protective coating deposited in a vacuum chamber.

40. A product in accordance with claim 29 wherein the protective coating has a thickness in the range between 1 monolayer and 1 μ , preferably between approximately 1 nm and approximately 500 nm.

41. A product in accordance with claim 29 wherein the sheet metal comprises aluminum, chrome-plate aluminum, copper, stainless steel, chrome-

plated stainless steel, titanium, titanium alloys and iron-containing compounds both with and without metallic coating, with the metallic coating including at least one of the elements tin, zinc, nickel, chromium or alloys of these materials.

42. A product in accordance with claim 29 wherein the sheet metal product has a thickness in the range from about 0.001 mm to about 5 mm.

43. The cell of claim 1 wherein said metal oxide composition comprises metal oxide treated to ensure conductivity.

44. The cell of claim 1 wherein the said metal oxide composition comprises a doped metal oxide.

45. The cell of claim 1 wherein the metal oxide composition comprises an oxide of an element or alloy of an element selected from the group consisting of tin, zinc, indium, and mixtures thereof.

46. The cell of claim 45 wherein said doped metal oxide comprises a dopant which is selected from the group consisting of aluminum, chromium, silver, boron, fluorine, antimony, chlorine, bromine, phosphorus, molybdenum, carbon, and mixtures thereof.

47. The cell of claim 1 wherein said electrically conductive contact element conducts electrical current to or from said electrode.

48. The cell of claim 2 wherein said electrically conductive contact element conducts current from said electrode.

49. The cell of claim 23 wherein said electrically conductive contact element conducts current to said electrode.

50. An electrochemical cell comprising an electrode and an electrically conductive contact element facing said electrode for conducting electrical current, wherein said electrically conductive contact element has an electrically conductive and corrosion-resistant protective coating which comprises a doped metal oxide.

51. The method of claim 50 wherein said electrically conductive contact element comprises a substrate and said layer overlies said substrate.

52. A cell of claim 50 wherein said doped metal oxide is an oxide of an element or alloy of an element selected from the group consisting of tin, zinc, indium, and mixtures thereof.

53. The cell of claim 50 wherein said doped metal oxide comprises a dopant selected from the group consisting of aluminum, chromium, silver, boron, fluorine, antimony, chlorine, bromine, phosphorus, molybdenum, carbon and mixtures thereof.

54. A method for inhibiting degradation of an electrically conductive contact element in an electrolytic cell, by corrosive species in the cell, said method comprising, including a layer comprising fluorine doped tin oxide between said corrosive species and said electrically conductive contact element, to thereby inhibit corrosion of said electrically conductive contact element.